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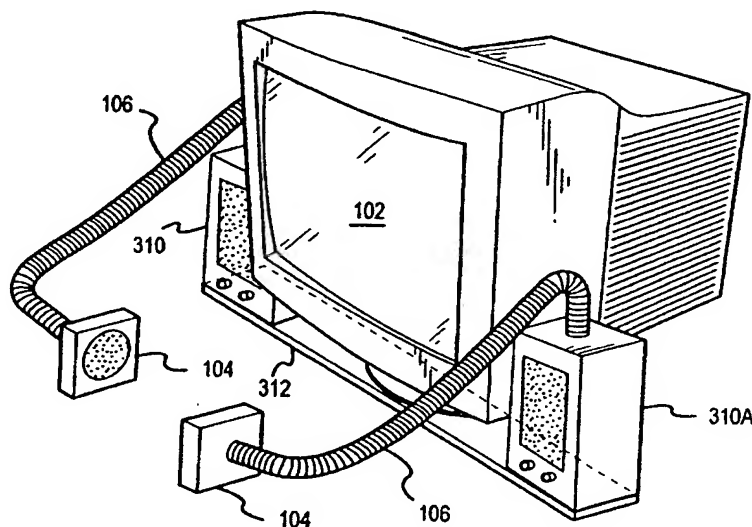
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(54) Title: LOUDSPEAKER MOUNTING SYSTEM COMPRISING A FLEXIBLE ARM



(57) Abstract

A mounting system for loudspeakers is provided. In general, the system comprises a flexible arm (106) having a first end and a second end. The first end of the flexible arm is suitably mounted to the loudspeaker (104). The second end of the flexible arm is suitably mounted to a surface. The surface may comprise a wall, another loudspeaker and/or a computer monitor. Various combinations and arrangements of speakers are disclosed, including mounting systems advantageously configured to provide surround sound experiences.

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LOUDSPEAKER MOUNTING SYSTEM COMPRISING A FLEXIBLE ARM

BACKGROUND OF THE INVENTION

1. Technical Field

5 The present invention relates, generally, to methods of mounting and positioning loudspeakers, and, more particularly, to a loudspeaker mounting system employing flexible arms to facilitate the convenient positioning of loudspeakers.

2. Background Information

Due in part to the widespread use of multimedia software and the availability of audio content over the Internet, the use of audio systems in conjunction with
10 computers -- particularly personal computer systems -- continues to rise in popularity. As a result an increasing number of computer users are configuring their systems with audio systems including loudspeakers, soundcards, disc player/recorders, DVD players, MP3 software players and other audio/video related peripherals, plug-ins and software. As popularity of audio for computers has increased, higher quality sound
15 and computer surround sound systems have also become important.

In some instances, the audio systems selected are the products provided with the multimedia system. Most new computers sold to consumers now include some kind of audio system as original equipment. However, the Original Equipment Manufacturer (OEM) speakers supplied by the computer manufacturer are often limited in terms of
20 performance; that is, they are typically of low quality. To satisfy the demand for better quality audio, more computer manufacturers are now offering upgraded audio components, such as better quality loudspeakers and surround sound packages, to their customers as options with the purchase of new computers. In addition, customers can now choose from many higher quality aftermarket loudspeaker systems and
25 soundcards to improve the audio performance of their computers.

Such loudspeakers (whether OEM or after-market) are typically affixed to the sides of the computer monitor or are built in to the monitor, CPU case or keyboard. These arrangements are convenient, in that they tend to maximize the use of scarce desk space and often place the speakers in a better acoustic location. Alternatively,

and as is particularly the case with many after-market loudspeakers, the speakers are configured to be placed on the desktop.

In those known systems where the speakers are affixed to the computer system, the speakers are generally attached to the sides of the computer monitor, often using
5 hangers, clips, or other types of hardware. These systems, however, are limited to, among other things, the wide variety of monitor sizes and shapes available. That is, mounting hardware which is fashioned to be used with monitors having a particular range of sizes, profiles, surface textures, and other design characteristics, is not likely to work with a large portion of the systems purchased by consumers. This is
10 particularly the case with new systems employing modern features such as flat-panel displays and the like. Stated another way, the mechanisms for mounting loudspeakers to a monitor are not standard from one manufacturer to another, and many monitors have no facility at all for mounting loudspeakers.

As a result, upgrade loudspeaker options and aftermarket computer
15 loudspeakers are usually designed to sit directly on the desk top, or some other surface. This often contributes to desk top clutter and forces the computer user to surrender precious space on their desktop. In addition, the desk top location may degrade performance if the loudspeakers are not tall enough or are obscured by other items on the desk.

20 One popular loudspeaker configuration is the so called "subwoofer-satellite" system. This system uses two small satellite speakers for the mid and upper range of the two stereo channels and adds a small "subwoofer" to handle the mono blended lower frequencies from the two channels. The satellite speakers require very little desk space, and the subwoofer, due to its non-directional sonic characteristics, may be
25 placed on the floor or tucked away out of sight. While this arrangement offers some advantages, the desktop placement of the satellite speakers still increases desktop clutter and often tends to reduce the overall acoustic performance of the system. In addition, the numerous wires required to connect the subwoofer, the two satellites, and the computer system, also contribute to clutter. The situation becomes worse for
30 surround sound systems which may include two rear channel loudspeakers, a center channel loudspeaker and a subwoofer in addition to the usual front left and right loudspeakers. Finding a place for the rear channel or surround loudspeakers is

probably the most difficult problem for anyone who wants surround sound with their computer.

Various attempts have been made to solve the problem of where to put computer loudspeakers. Aftermarket add-on kits are available for attaching speakers to
5 monitors. However, there is no guarantee that a particular mounting kit will work with any given combination of speakers and/or the computer monitor, in part, due to the lack of any standardized features which would facilitate loudspeaker mounting.

While odd speaker arrangements are known, such as for example, the combined lamp and loudspeaker arrangement shown in U.S. Patent 2,924,661, issued February 9,
10 1960 to Messeas, Jr., such arrangements would not readily facilitate the convenient placement of loudspeakers, in most practical applications, let alone the flexible and convenient placement of computer loudspeakers. Moreover, the teachings of the '661 patent would not readily suggest the convenient placement of loudspeakers, particularly those having enhanced performance, over a broad range of locations.

15 Systems are therefore needed in order to overcome these and other limitations of the prior art. Specifically, there exists a long felt need for a loudspeaker mounting system which enables conservation of desk space and allows convenience and flexibility in speaker placement and orientation.

BRIEF SUMMARY OF THE INVENTION

20 The present invention addresses the shortcomings of the prior art by providing mounting systems which employ one or more devices configured with flexible arms to enable a space-efficient, flexible method of positioning loudspeakers. While the way in which the present invention addresses the prior art disadvantages will be described in greater detail hereinbelow, in general, a mounting system in accordance with various
25 aspects of the present invention includes a flexible arm having a first end and a second end, wherein the first end is attached to a loudspeaker, the second end is fixed to a surface, and one or more wires are disposed therein for providing audio signals to the loudspeaker. The various configurations which can be obtained through use of such a mounting system are numerous and various modifications of the preferred
30 embodiments disclosed herein will be suggested to the skilled artisan in light of the

following detailed description; these and other modifications are intended to be within the scope of the present invention.

5 In accordance with one aspect of the present invention, one end of the flexible arm includes a bracket permitting wall-mounting of the arm, which may include an amplifier assembly.

In accordance with another aspect of the present invention, a pair of loudspeakers connected via corresponding flexible arms are configured to be desk mounted or removably attached to a computer monitor. Various attachment mechanisms are possible.

10 For example, in one embodiment of the present invention small left and right loudspeakers comprising at least one transducer and a suitable enclosure are mounted respectively on the first ends of first and second (e.g. left and right) flexible arms of sufficient length and of such a design that they can be flexibly configured, preferably by hand, to take whatever shape is required to hold the loudspeakers in the desired
15 position indefinitely. The other second end of each flexible arm is preferably attached to a mounting device or mounting base, depending on the intended configuration. For example, the intended application may involve connection of the loudspeaker to a computer system and/or in proximity to a computer monitor. If the system is being supplied as original equipment (OEM) with a computer and monitor which permits
20 attachment of loudspeakers to the monitor, the mounting device may attach the flexible arms directly to the monitor or to loudspeakers which can be attached to the monitor. In case the system is intended to sit on a surface such as a desk top or for wall mounting, a suitable weighted base or wall bracket can be attached to the non-loudspeaker end of each flexible arm.

25 In accordance with various other aspects of the present invention, various speaker and sound mixing systems may be incorporated into the mounting systems of the present invention. For example, the flexible arms may be provided with internal signal conducting devices to enable transmission of the electrical signals from a suitable amplifier to the mounted loudspeakers, and/or they may be suitably configured, for
30 example by being partially hollow, to contribute to the enclosure volume of the loudspeakers. In addition, subwoofer systems for reproducing sounds below the frequency range of the mounted loudspeakers may also be included as part of the

system. Where the mounting system of the present invention is used to facilitate surround sound, or in other desirable applications, the flexible arms and/or the mounting systems of the present invention may be provided with internal signal conducting devices for transmitting the electrical signals from an amplifier in a desirable manner. Suitable electrical mixing devices, and/or analog or digital signal processing devices may also be used to modify the electrical signal sent to the various mounted loudspeakers employing well known audio virtualization techniques to alter their apparent position, to, for example, provide an improved surround sound experience.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

The present invention will hereinafter be described in conjunction with the appended drawing figures, wherein like numerals denote like elements, and:

FIG. 1 is an isometric view of an exemplary loudspeaker mounting system in accordance with one aspect of the present invention;

FIG. 2 is an isometric view of an alternate loudspeaker mounting system in accordance with another aspect of the present invention;

FIG. 3 is an isometric view of a further alternate loudspeaker mounting system in accordance with yet another aspect of the present invention;

FIG. 4 is a prospective view of still another alternate loudspeaker mounting system in accordance with still another aspect of the present invention;

FIG. 5 is an isometric view of yet another alternate loudspeaker mounting system in accordance with yet another aspect of the present invention;

FIG. 6 is an isometric view of an alternate, wall-mount loudspeaker mounting system in accordance with another aspect of the present invention;

FIG. 7 is a cross-sectional view of an exemplary flexible arm in accordance with another aspect of the present invention; and,

FIG. 8 depicts an exemplary flexible arm in accordance with another aspect of the present invention.

DETAILED DESCRIPTION OF PREFERRED EXEMPLARY EMBODIMENTS

While the way in which the present invention addresses disadvantages of the prior art is explained hereinbelow in greater detail, in general, a loudspeaker mounting system generally includes a flexible arm having a first end and a second end, wherein
5 the first end is attached to a loudspeaker, the second end is fixed to a surface, and one or more wires are disposed therein for providing audio signals to the loudspeaker.

The various embodiments described below may be illustrated in the context of a computer system which includes at least a conventional PC and monitor; nevertheless, the present invention may be employed in a variety of other contexts, for example, as a
10 stand-alone loudspeaker system, a television loudspeaker system, or in any other application requiring flexible positioning of loudspeakers. It should be understood that the following descriptions of preferred exemplary embodiments illustrating use of the present invention in connection with conventional PC and monitor systems are illustrative only, and that use of the features and various aspects of the present
15 invention disclosed herein can readily be modified for use in connection with other contexts. Stated another way, the illustrated embodiments are not intended in any way to limit the scope of the invention as set forth in the attached claims.

Referring now to **FIG. 1**, an exemplary loudspeaker mounting system comprises a set of loudspeakers 104 secured to an amplifier 108 via corresponding flexible arms
20 106. In this embodiment, amplifier 108 is suitably placed on the top surface 110 of a monitor 102, and flexible arms 106 are used to position loudspeakers 104 adjacent opposite sides of monitor 102. Suitable wiring (not shown) is preferably provided within flexible arms 106 to facilitate the communication of audio signals (e.g., stereophonic audio) from amplifier 108 to speakers 104.

25 The term "flexible" as used herein means, for example, with respect to arms 106, that while the arms may be deformed manually (or otherwise) to take a variety of shapes, once desirably positioned, they remain substantially fixed in that position during normal operation. Thus, in the context of this invention, flexible means selectable, configurable, adaptable, and the like, thus encompassing all of the various
30 mechanical constructs as are now known or are hereafter devised by those skilled in the art for accomplishing that purpose.

The term "flexible" as used herein also preferably connotes convenience, in that, preferably, movement of the flexible arms enables convenient positioning of the loudspeakers attached thereto. In this regard, convenience may refer not only to convenience in terms of the ready placement of the loudspeakers, such as, for example, to permit significant usability of usually relatively scarce desk space, but also, in certain applications, and in accordance with various (but not all) aspects of the present invention, enhanced acoustical performance of the loudspeakers which are to be mounted.

With continued reference to **FIG. 1**, amplifier 108, which functions to provide suitable audio information for transmission by arms 106 to speakers 104, may include a variety of conventional amplifier components well known in the art. In this regard, a number of standard amplifier controls 112 such as volume, treble, bass, etc. may be provided along the exterior of amplifier 108 to allow user-control of the audio signal. Those skilled in the art will recognize that a variety of manual and/or remote control actuators may be employed in this regard.

In the illustrated embodiment shown in **FIG. 1**, amplifier 108 is preferably removably attached to monitor 102 through a suitable connection method, for example, through the use of one or more suction cups (e.g., three suction cups along the underside of amplifier 108), Velcro brand adhesive segments, and the like. It should be appreciated, however, that amplifier 108 in accordance with various aspects, some of which will be described in greater detail hereinbelow, may be incorporated into one or more of the speakers which are mounted in accordance with the present invention, or alternatively, in connection with a sound card contained within the computer system. That is, in accordance with various aspects of the present invention, amplifier 108 need not be separately provided.

With continued reference to the illustrated embodiment of **FIG. 1**, an individual loudspeaker 104 may comprise any suitable sound producing device, for example, any one of many aftermarket loudspeakers available from Polk Audio. For example, loudspeaker 104 may comprise a 3" full range speaker disposed within a small enclosure. While speakers 104 as illustrated exhibit a rectangular shape, the present invention is not so limited; virtually any configuration may be employed, for example, round, oval and other configurations. Moreover, while the use of a pair of speakers 104 may be advantageous in many instances, an arbitrary number of loudspeakers may

be used. For example, in the context of the illustrated embodiment of **FIG. 1**, three, four or more speakers 104 may be suitably affixed to amplifier 108. Alternatively, one or more speakers 104 may be suitably affixed to speakers 104. In accordance with these various alternate embodiments of the illustrated embodiment shown in **FIG. 1**,
5 such further attachment of additional speakers can be made through the provision of similarly configured flexible arms, like flexible arms 106 illustrated in **FIG. 1**. In some instances it may also be appropriate to fixture one or more of the loudspeakers 104 with amplifier controls (e.g., volume and tone controls) or other fixtures.

Flexible arms 106 are preferably configured to allow adjustment of the position
10 and/or orientation of speakers 104. That is, arms 106 are flexible in that they can be manipulated manually within certain limits (defined by various geometrical factors), but act to keep speakers 104 substantially immobile after adjustment. For example, arms 106 preferably enable manipulation of speaker 104 on the order of about 5 inches to about 15 or more inches horizontally from a center point. Preferably, such
15 manipulation is in the order of about 8 to about 12 inches from a center point.

Referring now to **FIG. 7**, an exemplary cross-sectional structure for a flexible arm 106 comprises a series of interlocking hollow beads 302 enclosed within a flexible sheath 306 (e.g., a corrugated rubber sheath). Interlocking beads 302 are preferably configured to allow one or more signal wires 304 to be disposed therein. It should be
20 appreciated, however, that the exemplary structure shown in **FIG. 7** is for illustration purposes only. Various other now known or hereafter devised flexible support structures can be utilized in accordance with the various aspects of the present invention. For example, in lieu of interlocking beads 302, flexible sheath 306 may be suitably configured to permit manipulation, yet by its nature permit substantially stable
25 fixation of speaker location. However, in this regard, it should be appreciated that speakers in the context of the present monitor refer generally to those speakers described herein, that is those which are generally capable of reproducing frequencies down to on the order of about 200 to about 250 Hz of acoustical output of about 80-90db SPL at 0.5 meters.

30 Alternatively, flexible arms 106 may be suitably configured to enhance and/or aid in acoustical performance of the loudspeakers mounted thereby. For example, in accordance with another aspect of the present invention, the partially hollow nature of

flexible arm 106 may be used to contribute to the total enclosure volume of the corresponding speaker 104. That is, arm 106 may be coupled to speaker 104 such that its volume is integral to the acoustic performance of the system. For example, in the case where flexible arm 106 has an inner diameter of about one inch, a ten-inch
5 segment of such an arm would have an effective internal volume of about eight cubic inches. If this arm were to be used in conjunction with a small loudspeaker with, for example, a three-inch cube enclosure having a volume of twenty-seven cubic inches, then the volume of flexible arm 106 would add about 30% to the effective enclosure volume of the loudspeaker. This added volume could then be used to improve the bass
10 response or efficiency of the speaker. Of course, the specific configuration of any particular flexible arm can be chosen for any desirable application. For example, in cases where the length of the arm is significant, only a portion (or none) of the length may be configured in the aforementioned partially hollow configuration.

In accordance with various other alternate embodiments of the present invention,
15 the flexible arms, for example flexible arm 106, may be suitably provided with internal signal conducting devices to enable transmission of the electrical signals from a suitable amplifier to the mounted loudspeakers. For example, referring now to FIG. 8, in accordance with yet another aspect of the present invention, flexible arm 106 preferably comprises a first fixture 502 coupled to one end of arm 106 permitting
20 attachment to a loudspeaker (not shown), and a second fixture 504 coupled to a second end of arm 106 permitting mounting to a surface (not shown), wherein said first and second brackets are connected to one or more wires disposed within arm 106 for communicating audio signals between said first fixture and said second fixture. The electrical and mechanical characteristics of fixtures 502 and 504 may vary in
25 accordance with the speakers and mounting units to which arm 106 will connect.

The electrical and mechanical characteristics of fixtures 502 and 504, or other fixtures which may be provided at distal ends of flexible arm 106 or at any point therebetween, may be suitably configured to facilitate other desirable attributes. Suitable electrical mixing devices, and/or analog or digital signal processing devices
30 may also be used to modify the electrical signal sent to the various mounted loudspeakers. For example, in connection with applications configured to facilitate a surround sound experience, well-known audio virtualization techniques to alter the

apparent position of the loudspeaker may suitably be employed. One known technique, for example, involves transmitting a Left minus Right channel signal to the left rear channel loudspeaker and a Right minus Left signal to the right rear channel loudspeaker to enable the production of an expanded sound field from the two channels. Other virtualization or sound enhancing methodologies now known or hereafter devised by those skilled in the art also may be used.

In accordance with another embodiment of the present invention, a stand-alone cabinet may be used to anchor the speakers. More particularly, referring now to FIG. 2, a speaker mounting system comprises speakers 104 attached via flexible arms 106 to a cabinet 402. Cabinet 402 is preferably sufficiently stable (or is sufficiently secured to the underlying surface) to prevent toppling of the apparatus due to the weight of speakers 104 or manual manipulation of flexible arms 106. In this embodiment, cabinet 402 preferably includes an amplifier (not shown) and a suitable subwoofer for handling mono blended lower frequencies. That is, speakers 104 may be used in conjunction with a subwoofer provided within cabinet 402 to provide what is often termed a "subwoofer satellite" system.

The illustrated embodiment of FIG. 2 may also be readily modified. For example, although only two speakers 104 are shown as being attached via flexible arms 106 to cabinet 402, other speakers 106 (not shown) may also be similarly attached. In some applications, for example, four (or more) speakers 106 may be similarly attached to cabinet 402 and the position of such speakers selected to enhance acoustical performance or other aesthetics. In other applications, a single speaker 104 may be utilized in connection with cabinet 402 (not shown). Still further, another single speaker 104 may be attached not to cabinet 402, but rather to the speaker 104 attached to cabinet 402. These and other arrangements may be utilized.

Moreover, cabinet 402 may be modified to be attached to monitor 102 or to fixtures to be used in connection with monitor 102. For example, referring now to FIG. 3, a further embodiment of a speaker mounting system of the present invention comprises speakers 104 which are attached via flexible arms 106 to respective first and second cabinet speakers 310, 310A (for example left and right front speakers). Preferably, a four channel amplifier may be built-in to one of the front speakers, for example front speaker 310A. Signal processing can be advantageously performed on

the signals sent to the rear channels, *i.e.*, mounted speakers 104, to provide and/or enhance the illusion of surround sound. In this regard, surround sound is used in its conventional sense and refers to true surround sound (*i.e.* properly recorded material which is replayed using multiple speakers in, for example, a 5.1 channel format) to perceived surround sound experiences. With respect to such perceived experiences, in general, the sound is reproduced by processed signals creating the impression of a spacious, immersive sound field as compared to, for example, normal stereo sound. Any now known or hereafter devised technique, manipulation or signal processing algorithm may be used in this regard to create such a surround sound experience. For example, the aforementioned Left minus Right and Right minus Left adjustment mechanism may be used in certain cases.

As shown in FIG. 3, speakers 310, 310A are preferably mounted in proximity to monitor 102 in a secured manner. For example, this can be accomplished by attaching the speakers 310, 310A (that is, in the illustrated embodiment, Left and Right Front speakers) to a plinth 312 which is held in place by the weight of the monitor 102. However, as will be appreciated this is but one of the many possible mechanisms for supporting speakers 310, 310A with attached flexible arms 106 and speakers 104 (in this illustrated embodiment which may be advantageously oriented as attached Left and Right Rear Loudspeakers).

In accordance with this embodiment, plinth 312 may comprise any suitable material capable of receiving speakers 310 and 310A. For example, plinth 312 may comprise a metallic, plastic or other rigid material. Speakers 310 and 310A may be fixed to plinth 312 in a secured and/or releasably secured manner.

As should be apparent from the illustrated embodiment of FIG. 3, the mounting system in accordance with this embodiment of the invention advantageously provides the user with the ability to position speakers 104 for surround sound applications or to facilitate a surround sound experience.

In accordance with various aspects of this embodiment, and in order to minimize the structural requirements of flexible arms 106, speakers 104 are preferably selected such that they are small and light. In addition, preferably speakers 104 are configured to reproduce frequencies down to at least 200 Hz with maximum acoustical output of at least 88db SPL at 0.5 meters. In a preferred aspect of this embodiment of the

present invention, loudspeakers 104 of FIG. 3 comprise long throw drive units with a nominal diameter of 25mm, free air resonance below 300Hz, a neodymium magnet structure and reference level efficiency of approximately 76db/1 watt at 1m. The drive unit is preferably mounted in a sealed enclosure having a net internal volume of
5 approximately 50cc.

In accordance with various other aspects of this preferred embodiment, loudspeakers 310, 310A are configured to offer more extended bass response and greater acoustical output than the rear loudspeakers 104. While speakers 310, 310A preferably are dimensioned sufficiently to support flexible arms 106 and attached
10 loudspeakers 104, in addition each preferably comprise a drive unit nominally 2 inches by 3 inches, free air resonance below 200 Hz and reference level efficiency of approximately 82db/1 watt at 1m. The enclosure preferably is of the standard ported type having a net internal volume of approximately 1.25 liters and port dimensions 44mm long by 10.75mm in diameter.

In general, the power output for each of the front channels, e.g., speakers 310, 310A, is approximately 6 watts RMS into 4 ohms and the power output for the two rear channels, e.g., speakers 104 is approximately 2.5 watts RMS into 4 ohms. The frequency range for all channels is nominally from about 50Hz to about 20kHz. If the amplifiers are built into one or more of the speakers, amplifier power may be suitably
20 supplied via an external modular amplifier power supply connected to a plug in the appropriate speaker, preferably 310 or 310A. In this embodiment, the various, for example four, amplifier inputs (not shown) are suitably connected to an appropriate source, such as the Left and Right Front and Left and Right Rear outputs from a sound card offering surround capability. In the absence of discrete rear channel signals, Left
25 and Right Front channel signals may be combined to form a Left minus Right signal which is sent to the input of the Left rear amplifier and a Right minus Left signal which is sent to the input of the Right Rear amplifier. However, any other signal processing systems may be used to synthesize rear channel signals. In any event, preferably connection of the outputs of the four amplifier channels to the Left and Right Front
30 speakers and to the Left and Right Rear speakers may also be provided via internal wires, for example as may be carried within the hollow inner portion of flexible arms 106.

Flexible arms 106 are preferably configured in a manner similar to arms 106 discussed hereinabove, and thus should bend easily by hand into curved shapes and should hold speakers 104 in the desired position optimally indefinitely. Flexible arms also are advantageously configured to allow wires to be passed internally from the attached (rear channel) speakers 104 to the amplifier or other connection point at the other end of the flexible arm (not shown, but preferably contained within speaker 310 and/or 310A). In accordance with a preferred aspect of this embodiment of the present invention, flexible arms 106 have an extended length, preferably in excess of 12 inches, and more preferably are approximately 18 inches long. Flexible arms 106 may be constructed from interlocking plastic beads, such as shown FIG. 7, such as those manufactured by Lockwood Industrial Corp. and may be covered with a flexible rubber sheath for improved grip and appearance.

In certain circumstances, it may be desirable to attach arms 106 not to speakers 310, 310A but to monitor 102, or the keyboard (not shown) used in conjunction with monitor 102, or the CPU (not shown) or for that matter any aspect of the computer system used in connection with monitor 102. For example, in cases where speakers are built-in to the keyboard, speakers 104 may be attached directly to the keyboard (not shown) via flexible arms 106, and speakers 310, 310A may even be eliminated. In such a case, the sound card useful in connection with the computer system should be appropriately configured, as will be recognized by those skilled in the art. For example, left and right front speakers could be provided in the keyboard, and left and right rear speakers could be attached via flexible arms 106 to the keyboard.

In lieu of use of plinth 312 shown in FIG. 3, various other placement mechanisms may be used in connection with cabinet-type speakers 310, 310A. For example, and with reference now to FIG. 5, in accordance with a further preferred embodiment of the present invention, loudspeakers 310, 310A are suitably provided with keyhole mounting tabs to enable ready attachment to mounting slots contained on some models of computer monitors. For example, as shown in FIG. 5, speakers 310, 310A may be suitably provided with mounting tabs 316 which are suitably configured to engage mounting slots 314 contained on the exterior surface of monitor 102. While, as previously discussed, no standardized form of mounting slots are currently available, speakers 310, 310A may be provided with mounting tabs which meet with

corresponding mounting slots on certain computer monitors. For example, and in connection with a particularly preferred aspect of this embodiment of the present invention, speakers 310, 310A may be provided with mounting tabs 316 to specially correspond with mounting slots supplied with Hewlett Packard Pavilion PC's and many Compaq PC's.

5 It should be appreciated that in the context of this embodiment speakers 104 connected via flexible arms 106 may be provided as original equipment for the computer system, or as an after-market upgrade. For example, speakers 310, 310A may be specially configured to be used with or without flexible arms 106 and attached
10 speakers 104. In this manner, flexible arms 106 may be disconnected, for example, if provided as original equipment. Also, such a configuration enables flexible arms 106 with speakers 104 to be provided for attachment to speakers 310 and/or 310A at a time later than purchase.

Although not shown in **FIG. 5**, in accordance with various other aspects of this
15 embodiment of the present invention speakers 104 may be attached directly to monitor 102 via flexible arms 106. With momentary reference to **FIG. 6**, one end of flexible arm 106, i.e. the end not connected to speaker 104, may be suitably configured to include a mounting plate 202. When so configured mounting of speaker 104, for example, directly to monitor 103, can be readily facilitated.

20 Various other mechanisms may be employed for the facilitation of convenient mounting of multiple speakers to advantageously enable the provision of surround sound. For example, with reference now to **FIG. 4**, in lieu of the plinth structure of **FIG. 3**, a casing combining left and right front speakers and the plinth may be utilized. In accordance with various aspects of this embodiment of the present invention,
25 preferably a base 410 suitably comprises a front portion 412, a rear portion 414, and decorative apertures 416. As shown, front portion 412 is suitably configured to facilitate the convenient attachment of speakers 310, 310A, whereas rear portion 414 is suitably configured to facilitate the mounting and/or placement of monitor 102 thereon. The mounting system of **FIG. 4** is similar to that shown in **FIGs. 3** and 5
30 and, accordingly, can be appropriately configured to advantageously provide a suitable surround sound experience. For example, speakers 104 attached via flexible arms 106 to mounting base 410 can be conveniently placed as left and right rear speakers while

speakers 310, 310A can be configured as left and right front speakers. A center front speaker may be separately provided, or incorporated into one of speakers 310, 310A. Suitable surround sound manipulation techniques may also be employed.

From the disclosures set forth herein, particularly those of **FIGs. 3-5**, various other modifications will be readily apparent to those skilled in the art. These modifications may include modifications in the design arrangement and/or electrical or acoustic construction of the various speakers to facilitate advantageous acoustical performance. In addition, additional speakers, as may be desired, may be added to facilitate any particular desirable application.

Referring now to **FIG. 6**, a speaker mounting system in accordance with yet another embodiment of the present invention comprises a loudspeaker 104 fixed via a flexible arm 106 to a bracket 202. Bracket 202, which preferably includes appropriate amplifier connections 204, may be affixed to a vertical surface 208 (e.g., a wall) using a variety of conventional mounting techniques. Such techniques may include bolts, screws, adhesives, hook and loop and/or other securement devices to facilitate the fixed or releasable attachment of bracket 202 to a surface. In this regard, bracket 202 may be useful in various applications. For example, it may be desirable to mount bracket 202 on a wall adjacent the placement of a computer system including, for example, as noted herein above directly to computer monitor 102. In various other applications, it may be desirable to configure a mounting system for a particular application, for example, a computer application where front right and left speakers are provided, for example, as shown in **FIG. 1** or **FIG. 2**, and rear channel speakers are provided on an opposing wall in a manner, such as shown in **FIG. 6**. Of course, various other combinations of the various embodiments and/or aspects of the various embodiments of the present invention are also possible.

Although the invention has been described herein in conjunction with the appended drawings, those skilled in the art will appreciate that the scope of the invention is not so limited. Modifications in the selection, design, and arrangement of the various components and steps discussed herein may be made without departing from the scope of the invention.

CLAIMS

What is claimed is:

- 1 1. A loudspeaker mounting system for mounting at least one loudspeaker in
2 a convenient manner, the mounting system comprising:
3 a flexible arm having a first end and a second end;
4 wherein said flexible arm first end is attached to the
5 loudspeaker to be mounted; and,
6 wherein said flexible arm second end is attached to a
7 surface.
2. The mounting system of claim 1, wherein the loudspeaker comprises an
enclosure, and said enclosure is attached directly to said flexible arm first end in a
stable manner.
3. The mounting system of claim 2, wherein said loudspeaker comprises a
speaker configured to reproduce frequencies down to at least 200 Hz with a maximum
acoustical output of at least 88db SPL at about 0.5m.
4. The mounting system of claim 1, further comprising first and second
loudspeakers mounted to said surface in a convenient manner by first and second
flexible arms, each of said first and second flexible arms having first and second ends.
5. The mounting system of claim 4, wherein said first and second
loudspeakers attached to said surface via said first and second flexible arms are
movable about a center point of said surface in a stable manner.
6. The mounting system of claim 4, wherein said mounting system further
comprises an amplifier, said second ends of said first and second arms being attached
to said amplifier, and said first ends of said first and second arms being attached,
respectively, to said first loudspeaker and said second loudspeaker.

7. The mounting system of claim 4, wherein said first and second flexible arms are configured to enhance the acoustical performance of first and second loudspeakers.

8. The mounting system of claim 7, wherein said first flexible arm includes internal signal conducting devices to enable transmission of electrical signals to said mounted first loudspeakers.

9. The mounting system of claim 7, wherein said first flexible arm is partially hollow and contributes to the enclosure volume of said first loudspeaker.

1 10. The mounting system of claim 4 wherein said surface comprises a third
2 loudspeaker, said first flexible arm, operatively connected at its first end to said third
3 loudspeaker and at its second end to said first loudspeaker, said second flexible arm
4 operatively connected at its first end to said third loudspeaker and at its second end to
5 said second loudspeaker.

1 11. A loudspeaker mounting system for use in mounting at least two
2 loudspeakers, the mounting system comprising:

3 at least one first loudspeaker being contained in an
4 enclosure;

5 at least one flexible arm having a first end and a second
6 end;

7 at least one second loudspeaker being contained in an
8 enclosure; and

9 wherein said at least one second loudspeaker is attached
10 to said at least one flexible arm second end and said at least one
11 first loudspeaker is attached to said at least one flexible arm first
12 end.

12. The mounting system of claim 11, wherein the mounting system is configured for mounting at least two first loudspeakers in connection with a computer system.

13. The mounting system of claim 12, wherein said at least one of said first loudspeakers comprises a loudspeaker contained in a cabinet, said cabinet being configured for placement in proximity to said computer monitor.

14. The mounting system of claim 13, wherein said cabinet includes means for attaching said cabinet to said computer monitor.

1 15. The mounting system of claim 13, further comprising first and second
2 flexible arms each having first and second ends, and first and second second
3 loudspeakers, wherein said first ends of said first and second flexible arms are attached
4 to said cabinet, and wherein said second ends of said first and second flexible arms are
5 attached to said first and second second loudspeakers, respectively.

16. The mounting system of claim 11, wherein the mounting system is configured for mounting at least two first loudspeakers to a computer monitor.

1 17. The mounting system of claim 11 further comprising first and second
2 flexible arms, each having first and second ends, wherein said at least one first
3 loudspeaker comprises one first loudspeaker, wherein said at least one second
4 loudspeaker comprises a first second loudspeaker and a second second loudspeaker,
5 and wherein said first and second second loudspeakers are operatively connected to
6 said one first loudspeaker.

1 18. The mounting system of claim 17, wherein said at least one first
2 loudspeaker comprises first and second first loudspeakers, and wherein said first
3 second loudspeaker is connected to said first first loudspeaker via said first flexible arm
4 and said second second loudspeaker is connected to said second first loudspeaker via
5 said second flexible arm.

19. The mounting system of claim 18 wherein said first and second first loudspeakers are configured for placement in proximity to a computer system.

20. The mounting system of claim 19 wherein said first and second first loudspeakers are configured for attachment in proximity to a computer monitor.

21. The mounting system of claim 20, wherein said first and second first loudspeakers are configured for attachment to said computer monitor.

22. The mounting system of claim 21 wherein said loudspeakers are configured to provide a surround sound experience.

1 23. The mounting system of claim 11, further comprising:

2 first and second, first loudspeakers; and

3 a first, second loudspeaker;

4 wherein said first and second first loudspeakers are

5 configured for placement in proximity to a computer monitor,

6 said first end of said first flexible arm is attached to said first, first

7 loudspeaker and second end of said first flexible arm is attached

8 to said first, second loudspeaker.

24. The mounting system of claim 23 further comprising a second flexible arm having first and second ends, and a second, second loudspeaker wherein said first end of said second flexible arm is attached to said second, first loudspeaker and said second end of said second flexible arm is attached to said second, second loudspeaker.

25. The mounting system of claim 24, wherein said mounting system is configured to provide a surround sound experience.

1 26. A loudspeaker mounting system:

2 first, second, third and fourth loudspeakers;

3 first and second flexible arms, each of said arms having
4 first and second ends,
5 wherein said first end of said first flexible arm is attached
6 to said first loudspeaker and said second end of said first flexible
7 arm is attached to said second loudspeaker thereby operatively
8 connecting said second loudspeaker to said first loudspeaker; and
9 wherein said first end of said second flexible arm is
10 attached to said third loudspeaker and said second end of said
11 second flexible arm is attached to said fourth loudspeaker,
12 thereby operatively connecting said fourth loudspeaker to said
13 third loudspeaker.

27. The loudspeaker mounting system of claim 26, wherein said loudspeakers are arrangeable through manipulation of said first and second flexible arms to facilitate a surround sound experience.

28. The loudspeaker mounting system of claim 27 wherein said first and third loudspeakers are configured for placement in proximity to a computer system.

29. The loudspeaker mounting system of claim 28 wherein said first and third loudspeakers are configured for placement in proximity to a computer monitor.

30. The loudspeaker mounting system of claim 29 wherein said first and third loudspeakers are configured for attachment to said computer monitor.

1 31. A loudspeaker mounting system for improving the sound quality from a
2 computer sound system of the type wherein first and second loudspeakers are
3 connected to a computer system; the mounting system comprising:

4 first and second flexible arms; and
5 third and fourth loudspeakers,
6 wherein said first flexible arm operatively connects said
7 third loudspeaker to the first loudspeaker and said second flexible

8 arm operatively connects said fourth loudspeaker to the second
9 loudspeaker. '

32. The mounting system of claim 31, wherein the first and second loudspeakers are connected to a computer monitor of the computer system.

33. The mounting system of claim 31, wherein the first and second loudspeakers comprise cabinet type loudspeakers and are configured for placement in proximity to a computer monitor of the computer system.

34. The mounting system of claim 33, wherein said third and fourth loudspeakers are movable with respect to the first and second loudspeakers.

35. The mounting system of claim 34, wherein said third and fourth loudspeakers are configurable to facilitate a surround sound experience.

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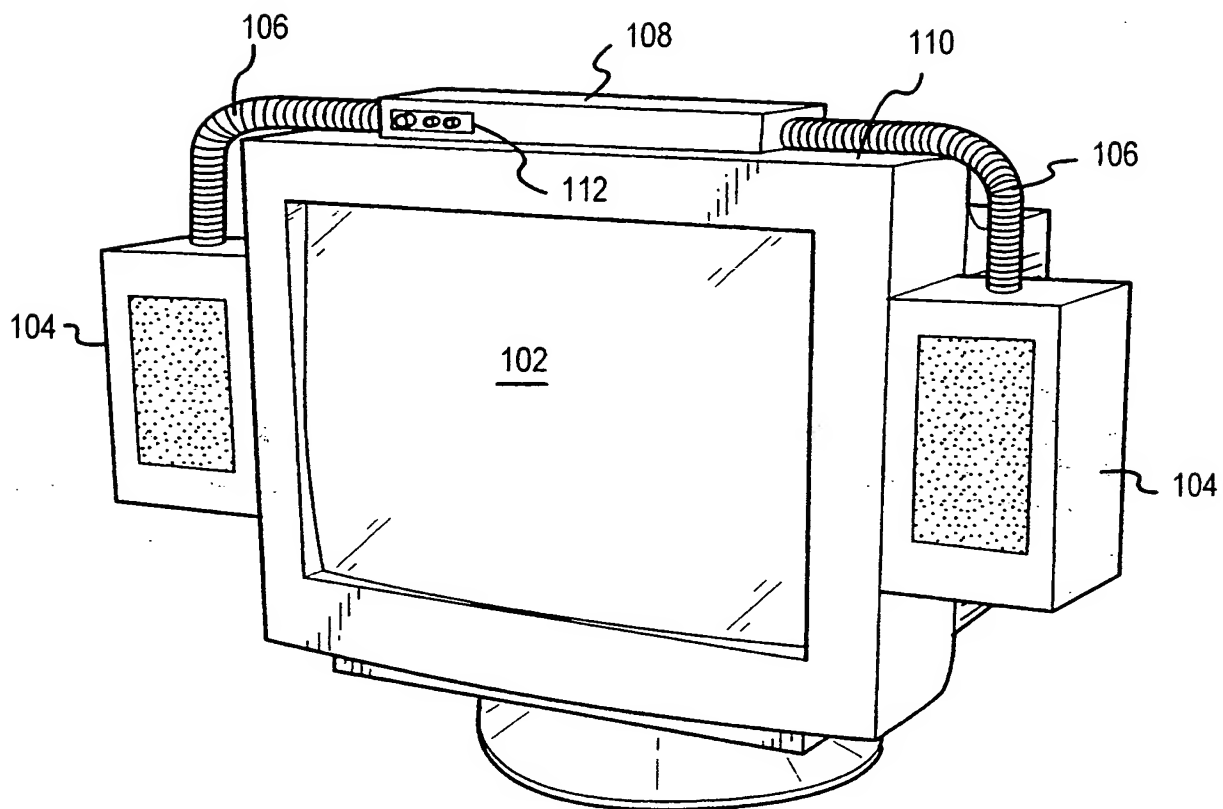


FIG. 1

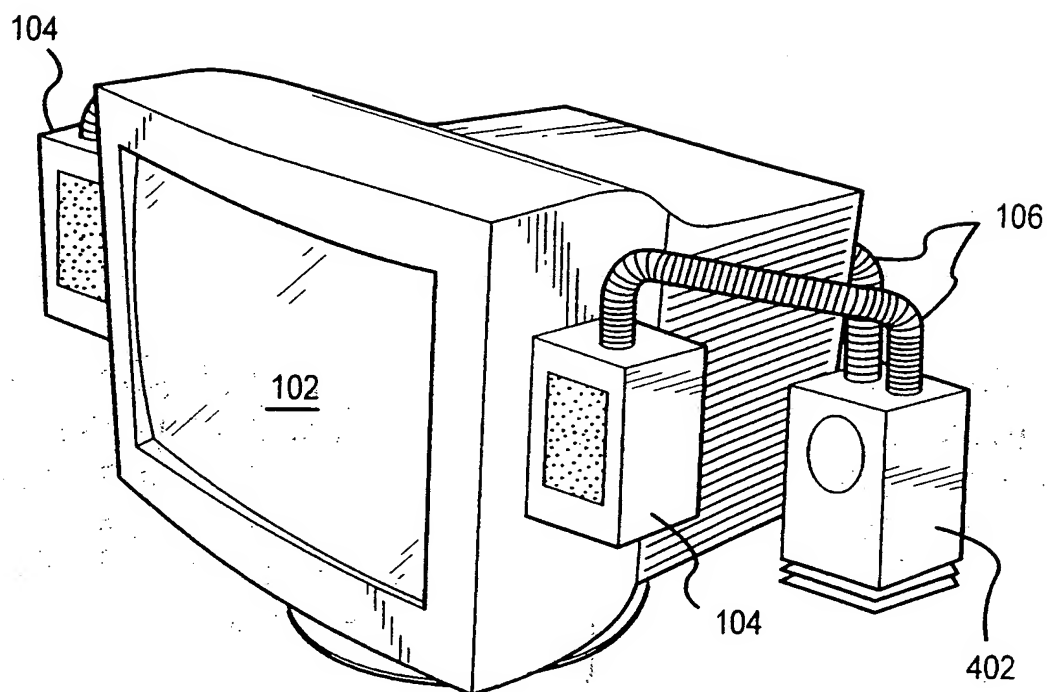


FIG.2

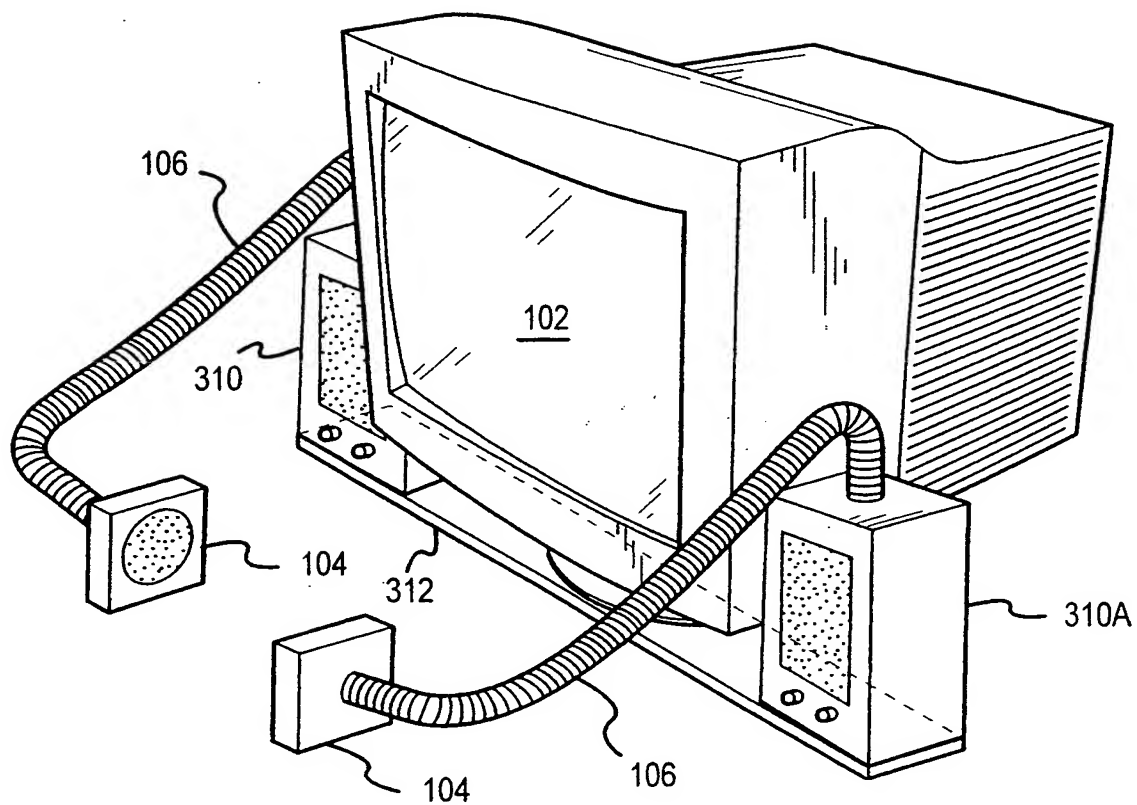


FIG.3

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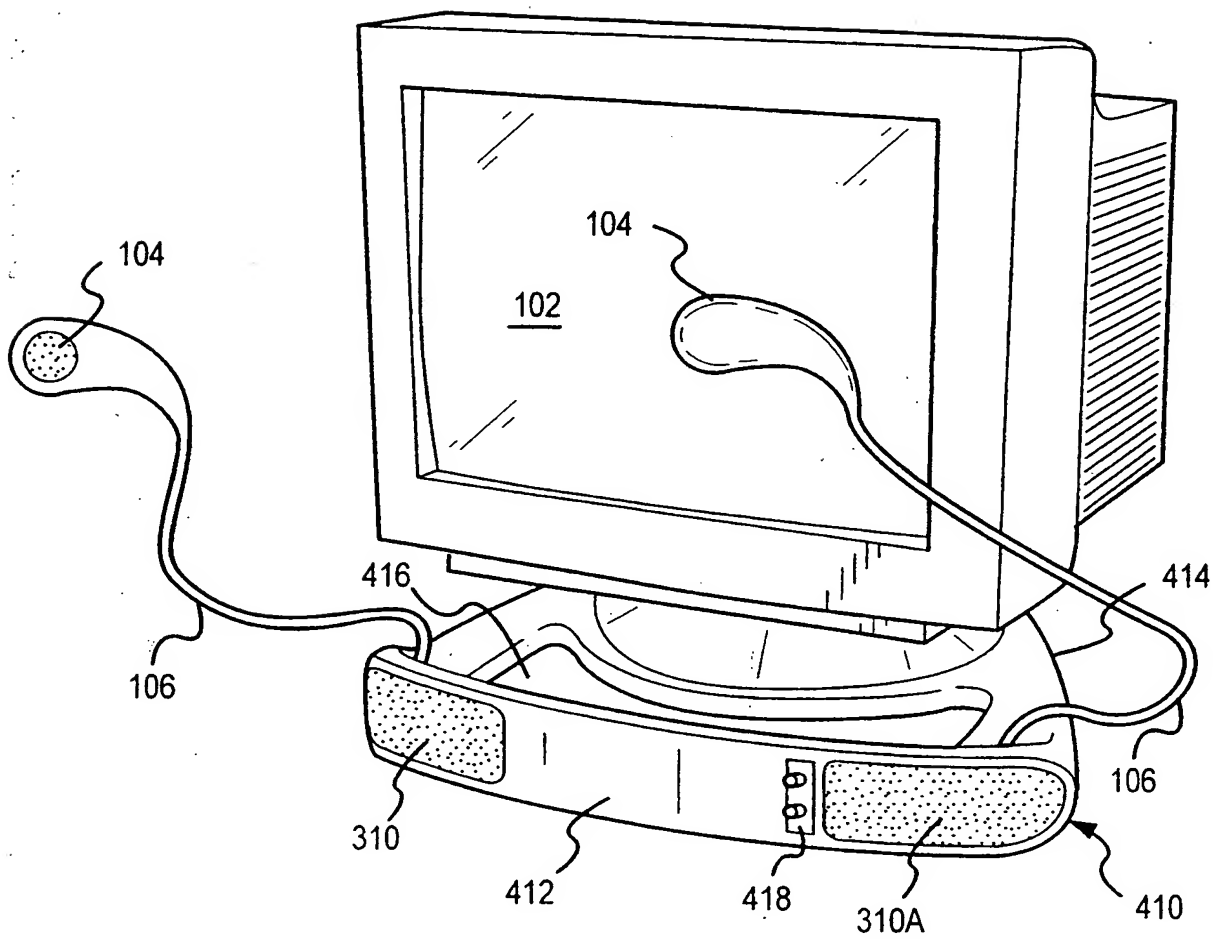


FIG. 4

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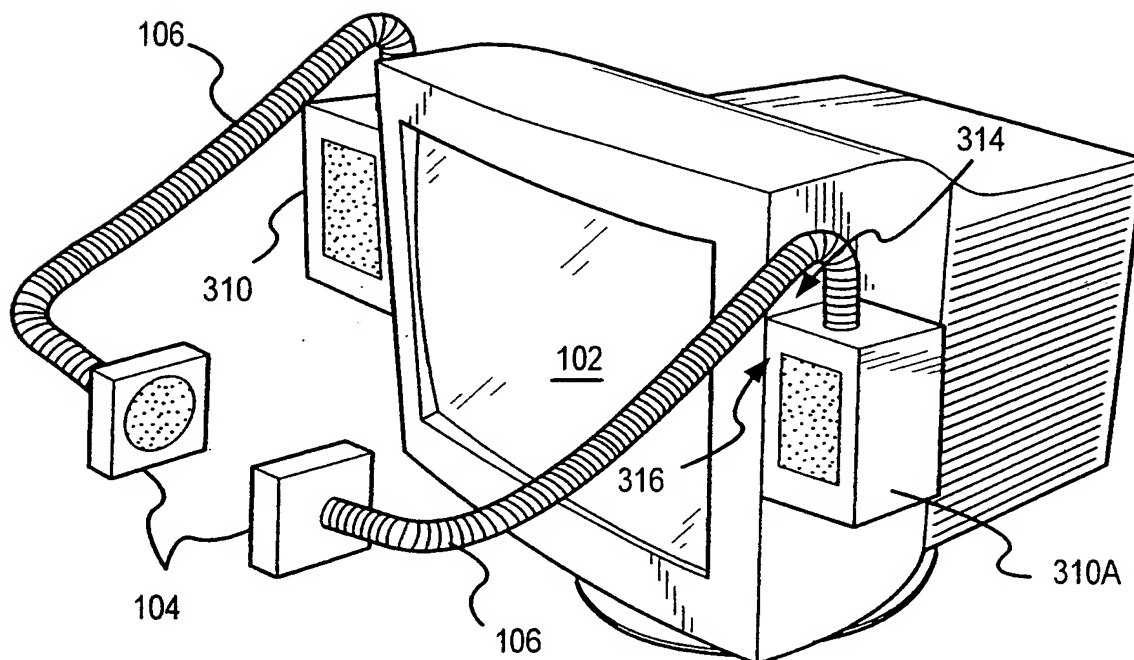


FIG.5

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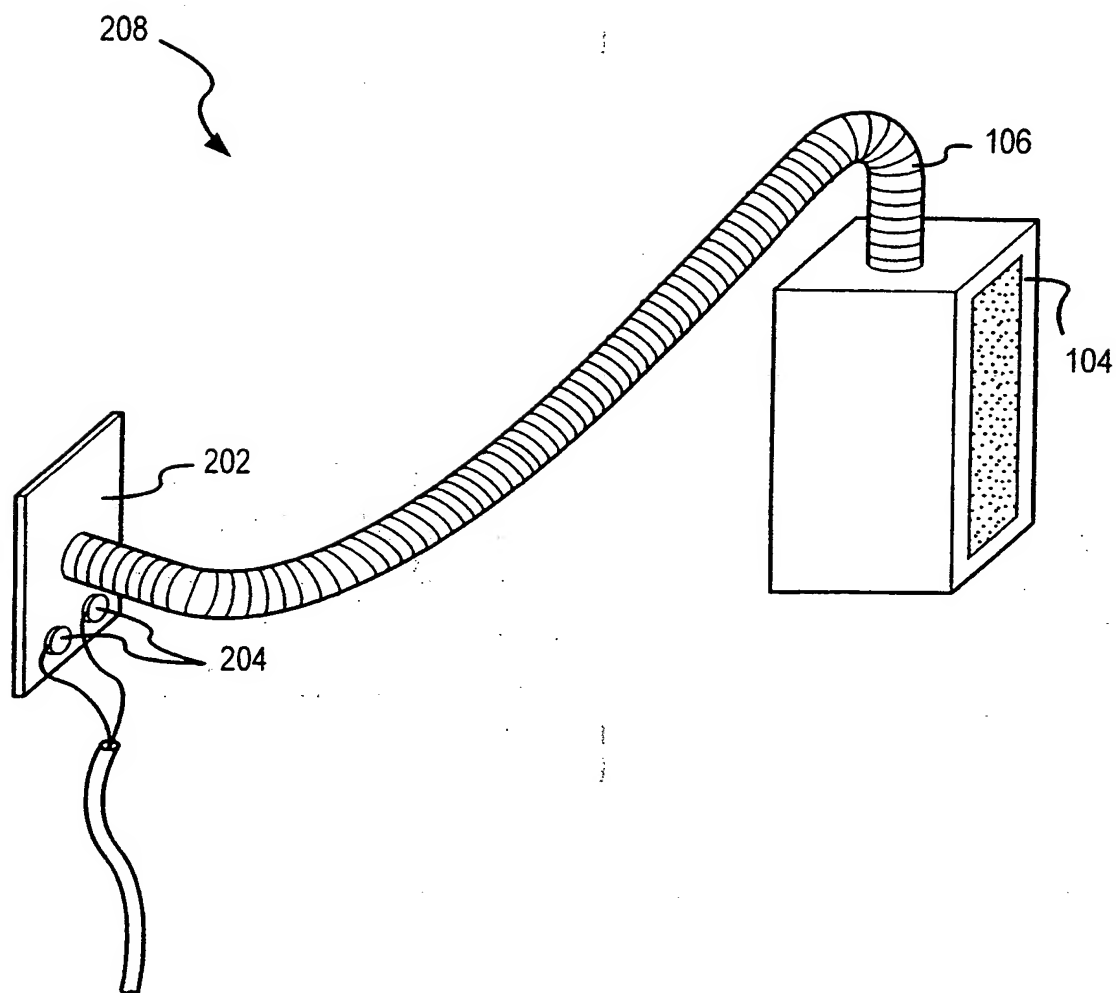


FIG. 6

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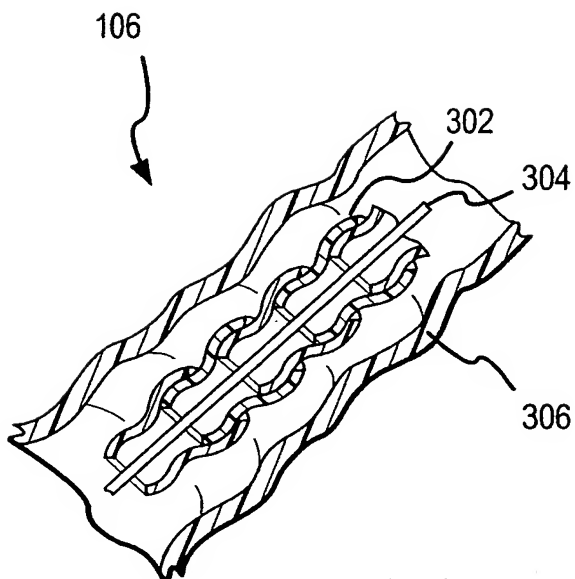


FIG. 7

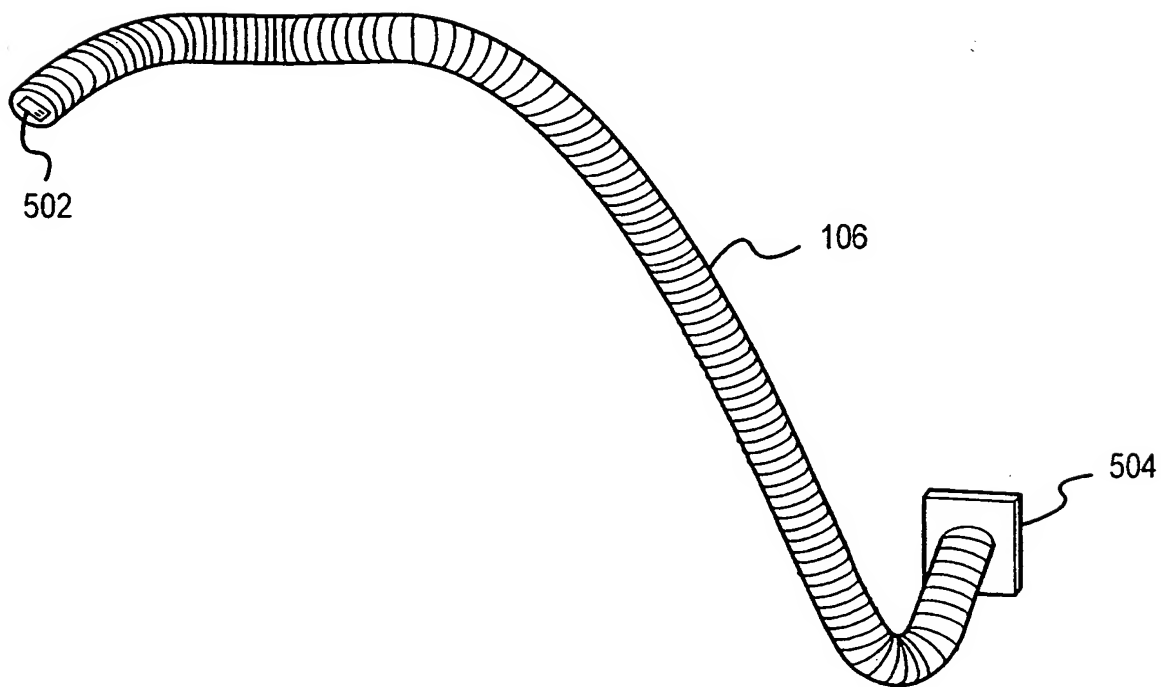


FIG. 8

INTERNATIONAL SEARCH REPORT

Int. Application No
PCT/US 99/31244

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04R1/02 H04R5/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04R F16M H04S H04N G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X | PATENT ABSTRACTS OF JAPAN vol. 013, no. 588 (M-912), 25 December 1989 (1989-12-25) & JP 01 247237 A (TOSHIBA CORP), 3 October 1989 (1989-10-03) abstract | 1-4 |
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| Y | --- | 5-10 |
| | --- | |
| | -/-- | |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *Z* document member of the same patent family

Date of the actual completion of the international search

26 May 2000

Date of mailing of the international search report

09.06.00

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Authorized officer

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INTERNATIONAL SEARCH REPORT

Int. Patent Application No.

PCT/US 99/31244

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-------------------------------------|
| Y | US 5 802 194 A (KAGAWA YUTAKA ET AL) 1 September 1998 (1998-09-01) figures 4,5,15,16 column 2, line 61 -column 3, line 59 column 5, line 6 -column 8, line 52; figures 3-5,7,8,12,13,15-18 | 5-10 |
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| P,Y | | 5-10 |
| X | DE 32 14 080 A (INST RUNDfunkTECHNIK GMBH) 27 October 1983 (1983-10-27) page 4, line 19 -page 7, line 20; figures 1-3 | 11-13, 15-26, 28-34 |
| Y | | 14,22, 25,27,35 |
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| Y | WO 98 20709 A (SRS LABS INC) 14 May 1998 (1998-05-14) page 11, line 10 -page 12, line 29 page 14, line 19 - line 31; figures 1,2,5 | 22,25, 27,35 |
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| P,Y | abstract | 14 |

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 99/31244

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-10

Claim 1 relates to a loudspeaker mounting system comprising:

- a flexible arm, having a first and second end;
- wherein the first end of which is attached to a loudspeaker and the second end to a surface. 'Note: not further specified!

2. Claims: 11-35

Claim 11 relates to a loudspeaker mounting system comprising:

- at least one first loudspeaker contained in an enclosure;
- at least one second loudspeaker contained in an enclosure;
- at least one flexible arm having a first and second end;
- wherein the first and second ends of said at least one flexible arm are attached to said at least one first and second loudspeaker, respectively.

Claim 26 relates to a loudspeaker mounting system comprising:

- first, second, third and fourth loudspeakers;
- first and second flexible arms, each having first and second ends;
- the first and second loudspeakers being attached to respective ends of the first flexible arm thereby operatively connecting said second to said first loudspeaker; and
- the third and fourth loudspeakers being attached to respective ends of the second flexible arm thereby operatively connecting said fourth to said third loudspeaker.

Claim 31 relates to a loudspeaker mounting system to be used with a computer sound system of the type wherein first and second loudspeakers are connected to a computer system, the mounting system comprising:

-) first and second flexible arms; and
-) third and fourth loudspeakers,
-) wherein the first flexible arm operatively connects said third loudspeaker to the first loudspeaker and the second flexible arm connects said fourth loudspeaker to the second loudspeaker.

Thus in a generalizing manner, claims 11-35 relates to a loudspeaker mounting system comprising at least one flexible arm having two ends (claim 11 one flexible arm and claims 26 and 31 two flexibles arms) wherein a loudspeaker is attached to each end of the flexible arm(s).

The application does not relate to one single group of inventions linked by a single general inventive concept as is required by Article 3 and Rule 13 PCT.

JP-A-1 247 237 discloses a flexible arm, one end of which is attached to a loudspeaker the other end of which to a surface of a car seat. The subject-matter of claim 1 lacks therefore novelty. Hence there can be no single inventive concept linking independent claim 1 with the other independent claims and neither can any of the features that claim 1 on the one hand and claims 11, 26 and 31 on the other have in common provide the necessary special relationship required by Rule 13(2) PCT. Thus, the requirements of unity of invention are not met.

For the sake of completeness the following is noted:

- In claim 1, strictly speaking neither the surface nor loudspeaker form part of the mounting system (cf. claims 4 and 6). This has, however, no bearing on the arguments given above.

- A comprehensive search would result in a major additional search effort e.g. in (sub)groups H04S3, H04R5/02, H04N5/65 and G06F1/16.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 99/31244

| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
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| JP 11055773 | A | 26-02-1999 | NONE | |